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# Optical Data Routing

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# Optical Data Routing

## Generic ODR 'Architecture'

### Required functionalities:

#### •Network interfaces: data encoding

Data transparency, bit interleaved

#### •Switch fabric

Space switch, Broadcast-and-Select fabric, Wavelength routed fabrics  
Switching times

#### •Contention Resolution

Wavelength, time, deflection, scheduling, buffers

#### •Switch Control and Configuration

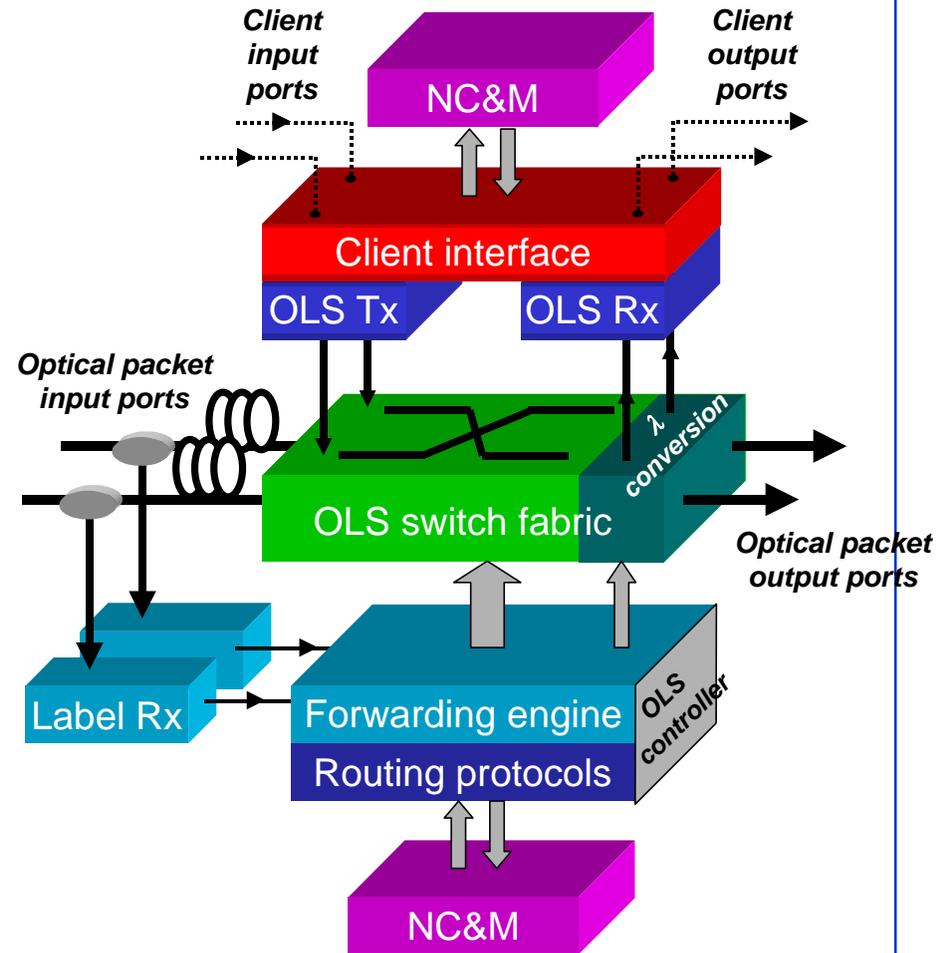
#### •Packet Header

- Inband vs out of band
- Label assignment, write,read
- Routing tables (buffers)

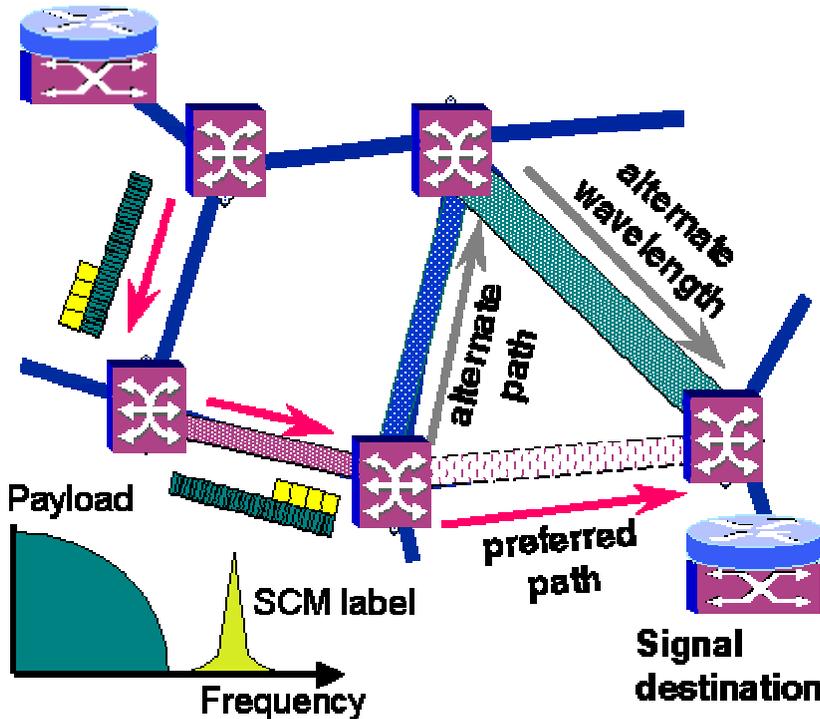
#### •Signaling channel

- None (connectionless), open loop (OBS) Optical Bursts, end-to-end: ((virtual) circuits), provisioned

#### •Network performance



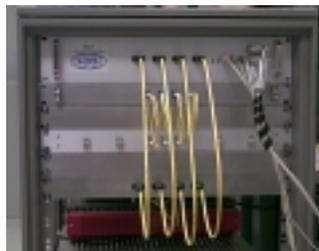
# ODR: An Example



**OLS edge node**



**OLS core node**

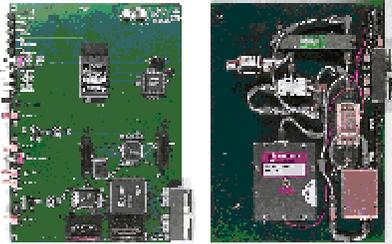


## • Optical Label Switching (OLS):

- OPS node and system arch.
- Edge & core node prototypes:
  - GbE payload, 1.25Gb/s header
  - LiNbO3 switch fabric
  - Network control & mgmnt protocols
- Subcarrier multiplexed (SCM) packet labeling
- Optical label swapping through SCM label filtering and rewriting
- Contention resolution through overcapacity,  $\lambda$ -conversion
- 4-end user node system demonstration of packet switching
- MPLS-based connection set-up

# ODR: Path to Integration

Optical data router:  
example subsystems



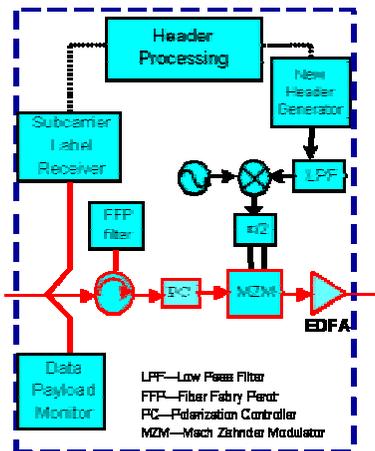
cPCI GbE client  
interface and 1.25  
Gb/s SCM header Tx

Label swapping



SCM header Rx  
and switch fabric/  
controller

Label  
swapping



- Technology tradeoffs

- *Functionality*
- *Performance*
- *Integration*

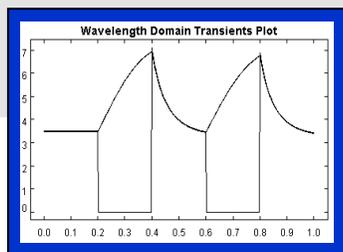
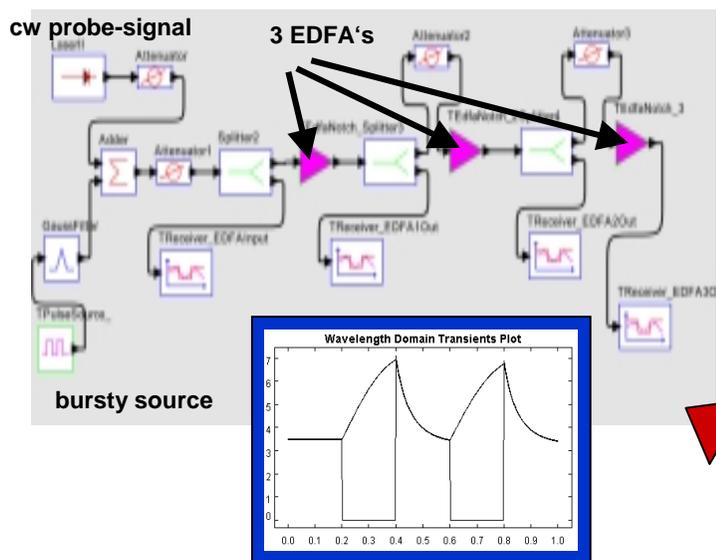
- ‘Box’ vs. Network:

- *Single ‘node’ vs end-to-end performance*
- *Many performance tradeoffs*
- *ODRouter, network, architectures interrelationships*

# ODR Networks: Networking simulation and testbeds

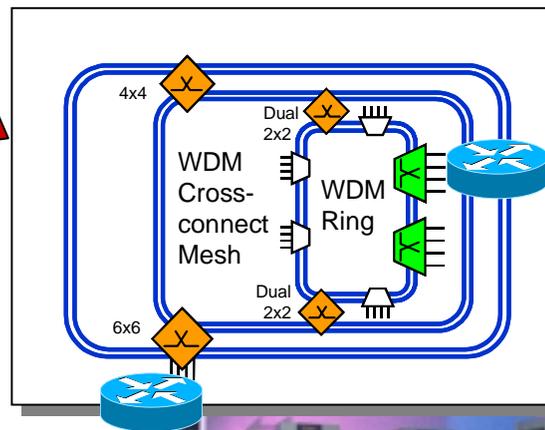
## Physical layer simulation

- Static and dynamic network simulation
- Network performance (impairments)
- Component and subsystem requirements
- Network scalability
- Placement of amplifiers, regenerators, etc



## Optical Network Testbeds

- Transparent optical networks, array of client/source equipment
- Investigating network concepts and component performance
  - interactions between components
  - interplay between traffic characteristics and network/components
  - network-level effects: e.g. timing and synchronization



# Network Architectures

- Network architecture and router capabilities are intimately related
- Overall network performance (latency, throughput, packet loss, etc) will depend on architectures and applications
- Some examples:
  - Wavelength conversion, how much and where?
  - Switch scale
  - Label address space
  - Impact of buffer size and placement on packet loss
  - Core and edge node functions/interfaces
  - Impact of packet aggregation
  - Impact of signaling mechanism on network performance
- Strategies for network resiliency
- ODR functionality within the larger context of transparent, reconfigurable optical networks

